Effects of Fe substitution for isoelectronic Ru on the magnetic and transport properties of CeRu$_2$Al$_{10}$

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We have investigated the effects of magnetic Fe ion substitution in Ce(Ru$_{1-x}$Fe$_x$)$_2$Al$_{10}$ on the magnetic and transport properties, when the Kondo insulator CeRu$_2$Al$_{10}$ with anomalous antiferromagnetic order at $T_N = 27$ K [1] is fully transformed into the archetypal non-ordered Kondo insulator CeFe$_2$Al$_{10}$ [2]. The characteristic Kondo temperature $T_K$ is determined from the magnetic susceptibility, and demonstrates a linear dependence on Fe concentration between 0.6 and 1. With increasing $x$, the positive maximum in the thermoelectric power just below $T_N$ enhances gradually and reaches up to $\sim 80$ $\mu$V/K (at $T = 40$ K) for $x = 0.8$, which is remarkably as high as $\sim 4$ and $\sim 1.5$ times the corresponding values in CeRu$_2$Al$_{10}$ and CeFe$_2$Al$_{10}$ respectively. The magnitude of the lattice thermal conductivity is found to be nearly independent of $x$, while the electronic thermal conductivity on the other hand decreases by an order of magnitude when $x$ increases from 0 to 0.8. We discuss our results in terms of the extreme electronic sensitive nature between CeRu$_2$Al$_{10}$ and CeFe$_2$Al$_{10}$.

References: